

AN
HISTORICAL ACCOUNT
OF

A New Method

For extracting the foul Air out of SHIPS, &c.

WITH THE
Description and Draught
OF THE

MACHINES;

By which it is performed :

In two Letters to a Friend,

By *SAMUEL SUTTON*, the Inventor.

The THIRD EDITION,

To which are annexed

Two Relations given thereof to the Royal
Society, by Dr. MEAD and Mr. WATSON:

AND

A Discourse on the SCURVY

By Dr. MEAD.

L O N D O N :

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THE
P R E F A C E.

I HAVE often said, that it is not, in our country at least, so easy a thing to serve the public, as is commonly imagined ; not meaning hereby the difficulty of finding out useful experiments, (although even that is great enough) but the hardships, which attend the putting them in practice. Whence this should come to pass, it is foreign to the present purpose to inquire. They who are acquainted with the several motives, upon which men often act, among which self-inter-

A 2 est,

est, envy, pride, and obstinacy, have no inconsiderable share, will readily see the springs of this seemingly unaccountable disposition of mind.

I would not have it thought, that I have had occasion to make this ill-natur'd remark, from what I may myself pretend to have done for the benefit of the public : but it is sufficiently justified by the opposition, which the invention described in the following treatise has met with. The machine is so simple, and of so extensive advantage, that as it is surprizing to see the greatest pains taken to make it abortive at first, so it is no less strange that it has not been so universally used, in the royal navy, as might have been expected from the great good, which it promises.

It

IT is not my business to examine the causes of this neglect ; which is in a very moving and handsome manner complained of in the voyage of the great lord *Anson* (a) ; an immortal work, which will be always read with a pleasure, equal to the benefit to be reaped from it, with regard to our navigation and commerce to those parts of the world, to which the adventures relate.

As this hero is not less admired for his humanity and good sense, than for his conduct and courage ; he has taken care that the relation of his enterprises should be a monument of the one, as well as of the other. The accounts given of that strange disease, so fatal to our seamen, *The Sea-Scurvy*, are hints

(a) See p. 36, 37.

so new and useful in physick, that I have thought it not unbecoming the place, with which I am honoured in my profession, to write a short discourse on this subject, and give it to the honest and ingenious author, to be published together with his reprinted *Account of a new method for extracting the foul air out of ships, &c.*: an invention, which I may venture to say, does honour to our nation, and will in time be found of more public benefit than any discovery in mechanics, which has been produced these hundred years.

HAVING therefore had the satisfaction, in the beginning, to recommend this experiment to the admiralty, I now join a short *discourse on the scurvy* to the reprinted edition of Mr. Sutton's book, as

a convincing and happy proof of the success, which attends it. And the author has also added some other authentic accounts to the same purpose. From all these things duly considered, it is to be hoped that the *evil spirit of opposition*, which, as is mentioned in Mr. Sutton's account, &c. exerted it self even against the making a trial, will now be *rebuked* and *cast out*.

To conclude, as any one versed in mechanics will easily see (as we formerly observed) that this management of the air may be applied to many other purposes of life ; (to some instances of which I have been an eye-witness) so it will prove a great loss to mankind, if it is not universally brought into practice : especially, since by the generosity and disinterestedness of the

the inventor, the whole expence may be considered as a trifle. Many more considerations might be urged ; but they will readily occur to the wisdom of those, whose province it is to direct our naval affairs.

THE foregoing Preface was written, and ready to be put to the press, when Mr. *Sutton* brought me the agreeable news, that the right honourable the lords of the admiralty had just then given him orders, to provide all the ships of his majesty's navy with this useful machine. Thus, laudable discoveries, though discountenanced at first, do at last break through all difficulties, and meet with suitable encouragement.

R. M.

A N

(I)



A N
HISTORICAL ACCOUNT
O F A
NEW METHOD
F O R

Extracting the foul Air out of Ships.

S I R,

P U R S U A N T to your desire,
I now send you an historical
account of my scheme, to-
gether with the reasons that first
inclined me to employ my thoughts
about it. In the year 1739, I was
informed by a gentleman, that the
sailors on board the fleet at *Spit-*
C *head*

head were so dangerously ill, for want of fresh air, that they were put ashore to recover their health ; and the ships to which they belonged, stunk to such a degree, that they infected one another. In compassion to my fellow-creatures, I thought myself obliged to do all that was possible for their relief in these unhappy circumstances, and from this time tried what could be done by fire. I at length found, that by stopping the air out of a room that had three fire-places, and making two large fires in two of them, I could bring the air to draw down the third chimney, with such force as to put out a candle. I then lighted a fire in the other chimney ; which so rarefied the air in the room, that the incumbent air pressed to enter in, and with a force sufficient to raise a pulley with half a hundred weight ;

weight ; and as soon as the room was cooled, by the coming in of the air, the door would shut, and then open again in three minutes.

HAVING proceeded thus far with good success, I stopped up all the chimnies in the house, the garret excepted, and then lighted two large fires, which drew the air down the chimney with such violence, as to put out four or five candles immediately : whereupon I concluded, that, a fire, being always kept on board a ship, and a pipe or cavity made to the well, one end of it being heated by fire, a change of air would follow, and that, by this means rendered sweet and pure, and fit for respiration.

FROM this time I made it my business to consult the officers and sailors of the navy, who all agreed

that such a change of air would be of the greatest use imaginable, in preserving the lives of the men on board his majesty's ships. I particularly remember, that, being at a coffee-house near the admiralty, I placed myself nigh some gentlemen of the navy, and enquired of them, as I had before of others, as to the usefulness of the fore-mentioned change of air, who all, to a man, acknowledged that it would be of the utmost service; and, upon their unanimous approbation of it, I told them that I could procure such a change of air; upon which one of the company went to another table, and the rest followed him; and I heard him tell the others, that he heartily pitied me, as being really mad, and out of my Senses.

U P O N

U P O N this unexpected treatment, I resolved to apply to some person of consequence in the navy, of approved integrity ; and well knowing that sir *Charles Wager* was a gentleman of this character, and withal of the greatest humanity, I waited upon mr *Gashery*, a commissioner of the navy, and acquainted him that I would communicate my invention to sir *Charles*, by word of mouth ; and that, if I did not, in a few minutes, convince him of its usefulness, I would withdraw immediately, without giving him any further trouble about it.

MR *Gashery* was so kind as to speak in my behalf to sir *Charles*, and thereupon I was introduced into his presence. I desired sir *Charles* to be so good as to permit
me

me to ask him some questions relating to my affair, which he was pleased to permit. I asked him, whether he had ever considered the principles, upon which the operations of the cupping-glass were founded? that, rarefaction being made in the glass, by means of the fire, and the glass pressed to the skin, the air in the blood presses out the skin; and, the skin being cut, and a second rarefaction made, the blood presses forward to the place where the rarefaction was made. I told him, that in like manner I proposed to procure a change of air on board his majesty's ships, by means of a fire in the cook-room, and laying proper pipes for that purpose.

SIR *Charles*, upon my discourse with him about my scheme, not
only

only expressed his approbation of it, but favoured me with the following letter to sir *Jacob Ackworth*, surveyor of his majesty's naval works :

S I R,

‘ **T**HE bearer hereof, mr
 ‘ *Sutton*, has found out a
 ‘ method to extract the foul air
 ‘ out of the wells of ships, which
 ‘ will be of great use for preserving
 ‘ the lives of the men aboard his
 ‘ majesty's ships. He will be wil-
 ‘ ling to talk with you, if an ex-
 ‘ periment can be made, so that
 ‘ he may not lose the benefit of
 ‘ the invention.’

I accordingly waited on sir *Ja-*
cob, who ordered me to come to
 him again, five days after, at seven
 in

in the morning ; at which time he being engaged in business, I waited at the office till evening, when he was pleased to express himself to me in the following words: ‘ Sir, I ‘ suppose you intend to throw air ‘ into the wells of ships.’ I answered, ‘ no, I proposed to draw ‘ it out, by means of fire.’ Upon this he asked me, ‘ if I knew how ‘ far I was to draw it out?’ I replied, ‘ not six inches: for, if ‘ I could extract it never so small ‘ a distance, the incumbent air ‘ would press forward of course, ‘ and, in so doing, cause a constant change.’ He admitted this. I then told him, that I waited upon him, by sir *Charles Wager’s* orders, in hopes that he would appoint a time for an experiment to be made of my scheme: to which he replied, ‘ that no experiment ‘ should

should be made, if he could hinder it.

UPON this disappointment, I petitioned the lords of the admiralty, and thereby obtained an order from them to the commissioners of the navy, to cause my experiment to be tried on board the *Greenwich* man of war, then lying at *Woolwich*. I forthwith carried their lordships order to *Woolwich*, and, pursuant thereto, to the satisfaction of myself, and all on board the *Greenwich*, I placed the pipes, and all things necessary for my experiment, except the foldering of two pipes: but, whilst the folder was hot, and the plumber in readiness to folder them, a messenger from the builder of his majesty's yard came to order the workmen ashore. I thereupon repaired to the builder, who acquainted me,

D

that

that I must apply to the navy-board, to procure an order to have my experiment performed on board the *Hulk* at *Woolwich*. I instantly replied, that, all the proper preparations being already compleated, except the foldering of two joints, which might be done in an hour's time, I desired it might be tried immediately. But to this he made answer, that I *must* apply to the navy-board, in order that they might procure an order from the lords of the admiralty for trying it on the hulk aforesaid. I thereupon told him, that I insisted on those two joints being foldered, that I might make my report to the lords of the admiralty, that I had faithfully executed their order; upon which, he assured me, they should be foldered that very night: but when I went on board the next day, to see if they were foldered, I
found

found them just as I left them the day before.

FINDING myself thus disappointed, I took a candle, and went down to the pipes, which were carried through deck, and laid under the beam, towards the well, about thirty feet in length from the copper; and, as soon as I put the candle to the ends of the pipes, they immediately extinguished the flame: which fully convinced those on board of the great usefulness of my invention. But to my extreme surprise, I no sooner came on shore, than I found, that the master afloat was sent from the king's yard, to take down my pipes, and plug up the holes: upon which, perceiving the obstructions my experiment would meet with, I determined to apply to some gentlemen of the faculty of physic, that

were proper judges of the usefulness of my scheme.

BEING no stranger to the character of Dr *Mead*, physician to his majesty, distinguished as much by his humanity as his abilities, I went directly to his house, shewed him sir *Charles*'s letter, and, by his appointment, the next morning came thither again, where I met the learned *Martin Folkes* esq; president of the royal society, whom the doctor had desired to talk with me, together with himself, upon my proposal. They both expressed their approbation of it, and most readily offered to do whatever was in their power, to encourage an invention which they judged must be of great service to the public. Accordingly Dr *Mead* immediately waited on the lords of the admiralty, and represented

sent to them, in a strong manner, the advantage of such a contrivance: whereupon they were pleased to order, that it should be tried, as soon as possible, on board any of his majesty's ships in the river.

BEING now left at my own liberty, to chuse a proper place for my experiment, I fixed upon the hulk at *Deptford*, because that was immoveable, and could not, like a ship, be sent away: and upon this I directly went to *Deptford*, in order to make the necessary preparations. I was soon acquainted there, that several of the workmen belonging to the king's yard were busily employed in trying the usefulness of another machine, industriously set on foot to supplant mine: but, after the strictest enquiry I have since been able to make,

make, I cannot learn that they had any orders to that purpose from the lords of the admiralty.

THIS proceeding, together with the excessive shyness and caution of the gentlemen of the yard, led me to conclude, that my scheme, at last, would be set aside, in spite, of all the steps I could take to prevent it; and I was confirmed in this opinion, when I found the pipes were made of wood, between five and six inches wide, in such an unworkmanlike manner, that, to render them tight, I was forced to get size and paper from *Deptford*, to put over the joints, and that moreover many hands were employed in erecting wind-sails, in order to shew, that they could thereby procure as much air as my scheme would afford.

AT

At length, in *September*, 1741, the day appointed for the trial of the experiment came; when the lords of the admiralty, the commissioners of the navy, Dr *Mead*, *Martin Folkes* esq; and several other members of the royal society, being present on board the said hulk; sir *Jacob Ackworth* was pleased to say in the hearing of them all. ‘I am sorry that you are
‘ come to see the trial of such a
‘ foolish experiment, that I tried
‘ myself yesterday, and it would
‘ not shake a candle.’ To this I replied, ‘It would be in good humour to-day, and the end of
‘ every one of the pipes would
‘ blow out a candle.’ And accordingly, notwithstanding the fore-mentioned obstructions, and that the tarpawlins were taken away, which I had ordered to be laid
over

over the hatches, I was as good as my word ; and all the lords and gentlemen aforesaid, upon the trial of my experiment, expressed their approbation of the performance.

IN *November* following, I was sent for by the messenger to the commissioners of the navy, and by them, pursuant to an order from the lords of the admiralty, sent down to *Portsmouth*, to prepare the *Norwich* man of war according to my scheme ; and, upon this occasion, sir *Charles Wager*, in the presence of the lords of the admiralty, honoured me with the following letter to commissioner *Hughes* at *Portsmouth*.

Admiralty-

Admiralty-Office, 24 Nov. 1741.

S I R,

‘ **I** Send this by mr *Sutton*, who
‘ has found out a way to draw
‘ bad air out of close places, par-
‘ ticularly from wells of ships,
‘ which you know are sometimes so
‘ bad, as to stifle men before they
‘ can be drawn up; as happened
‘ on board the *Lynn*, while I was
‘ at *Helvoet-Sluis*; one man being
‘ killed by it, and two narrowly
‘ escaped. This contrivance is ap-
‘ proved by much wiser men than
‘ I am in such things; and there-
‘ fore I desire you would let mr
‘ *Sutton* have all the encourage-
‘ ment and assistance you can give
‘ him. I take mr *Alleyn*, your
‘ builder, to be an ingenious man;
‘ E if

‘ if you recommend mr *Sutton* to
 ‘ his care, he will see that he meets
 ‘ with no obstruction or discour-
 ‘ ragement from any body, that may
 ‘ think themselves wiser. There is
 ‘ an order from this board to the
 ‘ navy, from whom you will have
 ‘ it, to have the *Norwich*, who is
 ‘ to go to the coast of *Guinea*, to
 ‘ be fitted according to mr *Sutton*’s
 ‘ scheme ; which will be a very
 ‘ good experiment.’ I am,

S I R,

Your humble Servant,

CHARLES WAGER.

THIS letter I carried down to
Portsmouth, and delivered to com-
 missioner *Hughes*, who received me
 in a very friendly manner, and re-
 commended me to mr *Alleyn* the
 builder ;

builder; who both of them (and indeed all the persons belonging to the yard) exerted themselves to the utmost of their power, to forward my undertaking; and at length I compleated it, agreeable to the plan I shall hereafter exhibit.

HAVING finished this business, I waited some days at *Portsmouth*, for a report signed by admiral *Le-stock*, and several commanders of ships, which captain *Gregory* gave me reason to expect: but, at last, (tho' to do the captain justice, I must own, that he treated me, whilst at *Portsmouth*, in an obliging manner) I was acquainted, that no report could be made, till the *Norwich* returned from it's voyage; which was sent to *Guinea*, and from thence to the *West Indies*: which constrained me to repent of my journey.

SOON after my return to *London*, I found things in the utmost confusion, by the sudden change of the ministry, which likewise occasioned a change in the admiralty. I petitioned however the commissioners of the navy, humbly requesting them to make a report of what I had done, from time to time, from the 10th of *July*, to the 10th of *December*, 1741, at *Greenwich*, *Deptford*, and *Portsmouth*, in compliance with the orders of the lords of the admiralty; in order that I might receive a suitable reward for my useful invention, and reasonable satisfaction for my trouble, loss of time, to the neglect of my other affairs, and expences in the execution of the same. But I received no answer, nor to many petitions I delivered to the lords of the admiralty themselves;

selves; until at length, justly moved at the cold and unkind treatment I met with, I freely expressed my sense of their hard usage, in the following petition.

*To the right honourable the lords
of the admiralty, the petition
of Samuel Sutton,*

Humbly sheweth,

THAT your lordships petitioner, having invented an useful scheme, for the extracting foul air out of his majesty's ships (which, in the month of *September*, 1741, was tried before the then lords of the admiralty, who approved the performance) lately applied to your lordships; but, to his extreme surprize, he finds, that he is not likely to receive any reward,

ward, either for the invention itself, or his loss of time and expences: nor are his majesty's sailors and mariners likely to receive any benefit from his scheme; tho' it is universally acknowledged, that more of them have lately died in *America*, for want of good air, than by the *Spaniards*. That your lordships petitioner cannot help remarking, that, tho' no invention ever met with more applause from the public than his, never was any man (himself excepted) employed by the lords of the admiralty, from time to time, at his own charges, as he has been, without a proper consideration. That your lordships petitioner now desires, that you would be pleased to consider him on that account, and order him a suitable satisfaction; and as in duty bound for your lordships he will

Ever Pray.

THIS

THIS petition was overlooked like the rest, nor was there any notice taken by the lords, either of me, or my scheme, till captain *Gregory* returned to *London*; who soon after his arrival, sent a letter to the then lords of the admiralty, in reference to the *Norwich* man of war, which I fitted up at *Portsmouth*; and the following extract of it was left at their office for me.

Extract of a letter from captain Gregory, late commander of his majesty's ship the Norwich, to mr Corbett, dated June 11, 1743.

‘ **A**S to the air-pipes which
 ‘ were put on board of me,
 ‘ I was obliged to stop up two of
 ‘ them,

‘ them, by reason the fire came
 ‘ down between decks: the other
 ‘ to the well was kept open, but
 ‘ the ship making water enough to
 ‘ keep her sweet, I was not able to
 ‘ judge of their use, having been so
 ‘ healthy as to bury only two men
 ‘ all the time I was on the coast.

Copy, *Tho. Corbett.*

I HAVE many remarks to make
 upon this letter, which by no
 means can be justly called a report,
 since the other officers, of the ship
 were not consulted; particularly
 the surgeon, and the carpenter, or
 other under-officers, the most com-
 petent judges; the former, of the
 health of the men; and the latter,
 of the sweetness and good condi-
 tion of the provisions. As to mr
Haddon the carpenter, who had
 been several voyages to *Guinea* be-
 fore,

fore, and never knew the like ; he assured me that the provisions continued entirely sound, and the men healthy, free from the scurvy or any other disorder, to the admiration of the people of *Barbadoes*, who therefore questioned, whether they had been at *Guinea*, or no : and indeed, this matter of fact, which is the main point, is for substance acknowledged by the captain himself ; tho' at the same time, he is pleased to say, ' that ' he was not able to judge of the ' use of my pipes.' This gentleman it seems lost so few men that he could not discover the usefulness of my pipes ; but, had he lost the greatest part of his crew, I dare say that he would have been able to judge, that my pipes were of no service at all. But, tho' the extract of the captain's letter carries its own confutation along with it ;

F

yet,

yet, as it was sent to the lords of the admiralty, I thought it expedient to give an answer to it, in the following letter to the earl of *Winchelsea*.

My LORD,

TH^{O'} I have petitioned the right honourable the lords of the admiralty several times, and even wrote to your lordship, in reference to my extracting foul air out of his majesty's ships, and never received any answer, except an extract from captain *Gregory's* letter; yet, in justice to my scheme, I apprehended myself obliged to lay before your lordship some just remarks on the said extract, which I hope will effectually remove any inferences that may be thence drawn, to the prejudice of my
useful

useful invention, which is founded on the most evident principles, and may be put in execution, at so easy a charge as about thirty pounds, in any of his majesty's ships. As to the captain, he says, that he was obliged to stop up two of my pipes, by reason some sparks of fire came down between the decks. But this might easily have been prevented, by adding two pipes of tin (which they never want) three feet long, and bringing them through the chimney, by which all communication would be cut off between those sparks and it. The captain also declares, that he could not tell, whether the pipe to the well, because of the water in it, was of use, or not ; but, which seems to be very unfair dealing, he entirely overlooks two other pipes. I intreat your lordship to be pleased to consider, that the pipes draw more

air than any kitchen-chimney, and what is sufficient to sweeten any ship in the navy. The captain himself owned to me, that not so much as one of his men had the scurvy, which cannot be said of any of his majesty's ships heretofore, or that out of such a number, so few have lost their lives, and so many have returned in perfect health from such a voyage: and indeed, if my scheme was generally put in practice, this, in all likelihood, would become a common case, nor would ships, that come from infected places, have any occasion to perform Quarentine, the air being preserved by the foresaid pipes, in a pure and wholesome state. I am,

My Lord, &c.

AND

AND as the principal, and indeed only, objection, in the extract against my scheme, was the danger of fire ; I wrote the following letter to sir *Jacob Ackworth*, his majesty's surveyor, in order to shew, that it was entirely groundless.

Honoured Sir,

WHEN a scheme is proposed for the good of mankind in general, and the preservation of the lives of his majesty's subjects in particular ; it is doubtless highly reasonable, that, as it is a matter of great consequence and importance, a strict inquiry should be made, whether it be practicable, and will effectually answer the end proposed. As to the inconveniency apprehended to attend

attend mine, that it will expose ships to the danger of fire, I intreat you to be so good as to enquire of any bricklayers, or builders, whether this apprehension be not entirely groundless. I could heartily wish that you would be pleased to satisfy yourself in this particular; as your declaration, on this point, in my favour, would have great weight with the lords of the admiralty; in order to my being by them appointed to have the directions of laying pipes on board his majesty's ships. I am, sir, firmly relying on your goodness,

Your humble

and obedient Servant,

SAMUEL SUTTON.

SOON

SOON after, when the plague raged in *Sicily*, and timely precautions were taken to prevent its being introduced hither, I again wrote to the earl of *Winchelsea*, as follows.

My LORD,

A Proclamation being issued out for ships to perform Quarantine, I humbly beg leave to acquaint your lordship, that if my scheme for extracting of foul air, was properly put in practice on board such ships, it would effectually preserve the health and lives of his majesty's subjects. And, such a sume being let down as the physicians may judge expedient, great advantages would arise, without any ill consequences whatsoever:

ever: because, the foul air being consumed by the fire, the fume, by means of a pipe let into the hold of the ship, will with ease be drawn down, there being a want of it to supply what is extracted. If your lordship will be pleased to consult the physicians, you will find that what I offer is practicable, being founded on just and rational principles. I am,

My Lord,

Your humble

and obedient servant,

SAMUEL SUTTON.

SIR *Jacob Ackworth*, mr *Al-
ley*n of *Deptford*, and the rest of
the surveyors will readily attest,
that no damage can arise from the
fire

fire made use of in my scheme; which is the only objection that has hitherto been advanced against it.

HAVING thus refuted the fore-
said objection, and I hope in a
convincing manner, it was natural
for me to expect, without any lon-
ger delay, a reward suitable to the
importance and usefulness of my
invention; but it was some time
after this, before I received the
following order from the lords of
the admiralty.

Extra.

*Received the 31 Oct. 1743.
No. 688.*

Mr *Treasurer*,

No. 2619. ' I N pursuance of an
1743. ' order from the
' right honourable the lords com-
' missioners of the admiralty, da-
G ted

' ted 22 *October* 1743, signifying
 ' that, whereas mr *Samuel Sutton*
 ' did, sometime since, propose to
 ' that board an invention of his,
 ' for extracting the foul air out of
 ' ships by fire, and letting in fresh
 ' air, an experiment of which was
 ' ordered to be made on board his
 ' majesty's ship the *Norwich*, bound
 ' to the coast of *Africa*; and cap-
 ' tain *Gregory*, who commanded
 ' the said ship, having since his
 ' return made a report thereof, a
 ' copy of which their lordships sent
 ' us therewith, whereby it appears,
 ' that it does not, in all respects,
 ' come up to the expectation, and
 ' that the use thereof is dangerous,
 ' and liable to accidents by fire:
 ' yet, as the said mr *Sutton* has
 ' employed a great deal of pains
 ' and time about the said inven-
 ' tion, for the benefit of the navy,
 ' and had encouragement from
 their

' their lordships so to do; and
 ' their lordships being desirous to
 ' give encouragement to persons
 ' who shall turn their thoughts to
 ' any inventions, that may tend to
 ' the advantage of the navy, do
 ' thereby desire and direct us to
 ' cause a bill of one hundred
 ' pounds to be made out to the
 ' said *Samuel Sutton*, as a reward
 ' for the loss of time and expences
 ' he has been at about the said in-
 ' vention.

' We pray you to pay unto mi
 ' *Samuel Sutton* accordingly, the
 ' sum of one hundred pounds, da-
 ' ted 22 Oct. 1743.

J. B.
 31. Oct, 1743.

Jam. Compton—Ca. Account.
Rich. Haddock.

J. B. No. $\frac{2360.}{359.}$ }

THIS, sir, was all the satisfaction I could procure from the lords of the admiralty, though I had from time to time, executed their orders with the utmost fidelity, and even that, not till above two years after the trial of my first experiment on board the hulk at *Deptford*: a satisfaction that scarcely defrayed my expences. But I am perswaded from what has been already said, you clearly perceive, that, as matters stood, if the usefulness of my scheme had appeared in the most demonstrative light, I should, after all, have fallen short of a suitable reward; and indeed, this is the truth of the case. Dr *Hales's* Ventilators, which were designed to answer the same purposes as my pipes, had, by some means or other, got such an ascendant in the esteem and regard of some

some leading persons in the affairs of the navy, as, in spite of conviction itself, to admit of nothing to come in competition with them; tho' even that darling scheme is now out of date and exploded. Far be it from me, to insult and triumph over a conquered adversary: and it is needless, as well as cruel, to spend much time in confuting a scheme, that experience has abundantly shewn to be absurd and ridiculous. However, I think it incumbent on me to observe, how much I was surprized to find no mention made by the candid author of the *Description of Ventilators*, of my invention: whereas he himself saw an experiment made before the royal society with a model of it, and heard Dr *Mead*'s account of it read to that learned body; which account was published in the *Philosophical Transactions* some
time

time before the book of Ventilators was printed. Upon the whole, this is a peculiar advantage attending my invention, that it's beneficial influences are perpetual, without the least intermission; whereas doctor *Hales* fully evinces the insufficiency of any attempts to make the air in ships wholesome, by only a few hours ventilation. 'It were
 ' to be wished (says he, *p*, 41.) that
 ' there should not be so much as one
 ' hour without ventilation, when
 ' the ports are shut.' His ventilators are cumbersome machines, taking up more room than can conveniently be spared, and require many hands to work them: my pipes take up no room, but what may be very well spared, and stand in need of no manual labour at all. His ventilators have only a casual and uncertain, but my pipes a certain and uninterrupted, effect.

His

His ventilators cannot extract the air from the well at the bottom of the ship; but mine do this, and introduce pure and wholesome air, in the place of impure and unwholesome. His ventilators, he tells us, will keep a prison sweet; but my pipes will sweeten even a bog-house, and may be conveyed miles under ground into the deepest mines and subterraneous cavities, with the same success. His ventilators require much more air than my pipes, which will admit of more or less, as shall be thought expedient. And, as my scheme, in all these respects, surpasses his; so his is dead and buried, without any hope of a resurrection, whilst mine rises in it's reputation daily: and the report of captain *Comyns*, commander of the *Fame* privateer, which I fitted up some months ago, and which is returned to *Lis-*
bon

bon with his crew in health and vigour, will give such an ample and satisfactory attestation of the safety and usefulness of my pipes, as will be sufficient to dispel the doubts and suspicions of the most incredulous.

To conclude: the simplicity of this machine ; it's easy stowage without being cumbersome ; it's operation without any labour to the seamen ; the small expence to put it in execution, and maintain it ; besides it's tendency to preserve the health and lives of the seamen, to keep the ship dry, and the merchandize from damaging ; are strong reasons why no ship should go to sea without it.

I am, *Sir,*

Your's, &c.

SAMUEL SUTTON.



An account of mr Sutton's invention and method of changing the air in the hold, and other close parts of a ship; communicated to the royal society by Richard Mead, M. D. physician to his MAJESTY, fellow of the royal society, and of the royal college of physicians, London.

Read Feb. 11. 1741-2.

IT is found by daily experience, that air shut up and confined in a close place, without a succession and fresh supply of it, becomes unwholsome, and unfit for the use of life.

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This

This is more fenfibly fo if any ftagnating water be pent up with it.

But it grows ftill worfe, if fuch an air as this is made ufe of in refpiration, that is, becomes moifter and hotter, by paffing and repaffing through the lungs.

Thefe bad effects, in different degrees, according to the different manner in which air is inclofed, are obferved in many cafes; particularly in deep wells and caverns of the earth, in prifons or clofe houfes, where people are fhut up with heat and naftinefs: but moft of all in large fhips, in which, with the ftench of water in the hold, many men being crouded up in clofe-quarters, all the mentioned circumftances concur in producing greater mifchief than would follow from any of them fingle.

The

The reason of these bad effects is this: it is that property of the air which is called it's elasticity or springiness, which makes it so useful to our life. When any part of it is inclosed and kept from the communication of the outward air, it expands itself, and, in proportion to the closeness of the place, loses it's spring; and if any heat or moisture comes to it, the elastic force may be quite lost and destroyed. And not only so, but if it happens to be impregnated with noxious *effluvia*, either from unwholesome substances of any kind, or from the infectious breath of diseased bodies; it will become quite poisonous and deadly, in a manner suitable to the original cause.

It is proposed at present to find out a remedy for this evil in ships only: but by making alterations according as particular places re-

quire, the same may be applied to any houses or parts of them, as prisons, the sick wards in hospitals, &c.

Now it is a natural consequent of the elasticity of the air, that when it is rarefied in any part, (which is most effectually done by heat) the neighbouring air will rush that way, till this part is brought to be of an equal density and elasticity with itself; and this again will be followed by the air next to it: so that, if a conveyance for air be laid from the hold or well of the ship, and a refaction of the air therein be made; the foul air from this place will run or be drawn out that way, and fresh air from the adjacent parts, will succeed in it's room.

It is upon these principles that the following scheme is most humbly

bly offered to the right honourable the lords of the admiralty, and commissioners of the navy, which it is hoped will be found effectual for clearing the bad and corrupted air from the holds and other close parts of his majesty's ships; and thereby prove beneficial to the public, by preserving the healths of many of his majesty's good subjects serving on board the same; the whole thing being indeed easy to be executed, and what will no way incumber, or be troublesome, in any of the vessels where it shall happen to be applied; the same being, in short, no more than this: that whereas in every ship of any bulk, there is already provided a copper or boiling-place proportionable to the size of the vessel; it is proposed to clear the bad air by means of the fire already used under the said coppers or boiling-places,

places, for the necessary uses of the ship.

It is well known, that under every such copper or boiler, there are placed two holes separated by a grate ; the first of which is for the fire, and the other for the ashes falling from the same ; and that there is also a flue from the fire-place upward, by which the smoke of the fire is discharged at some convenient place of the ship.

It is also well known, that the fire once lighted in these fire-places, is only preserved by the constant draught of air through the fore-mentioned two holes and flue ; and that if the said two holes are closely stopped up, the fire, though burning ever so briskly before, is immediately put out.

But

But if after the shutting up the abovementioned holes, another hole be opened, communicating with any other room or airy place, and with the fire; it is clear, the said fire must again be raised and burn as before; there being a like draught of air through the same, as there was before the stopping up of the first holes: this case differing only from the former in this, that the air feeding the fire, will now be supplied from another place.

It is therefore proposed, that in order to clear the holds of ships of the bad air therein contained, the two holes abovementioned, that is, the fire-place and ash-place, be both closed up with substantial and tight iron doors; and that a copper or leaden pipe, of sufficient size, be laid from the hold into the ash-place, for the draught of air to
come

come in that way to feed the fire. And thus it seems plain from what has been already said, that there will be from the hold a constant discharge of the air therein contained; and consequently, that that air so discharged must be as constantly supplied by fresh air down the hatches, or such other communications as are open into the hold: whereby the same must be continually freshened, and it's air rendered more wholesome, and fit for respiration.

And if into this principal pipe so laid into the hold, other pipes are let in, communicating respectively either with the well or lower decks; it must follow, that part of the air consumed in feeding the fire, must be respectively drawn out of all such places, to which the communication shall be so made.

To



T O

Martin Folkes, *Esq*;

President of the royal society.

S I R,

A Ccording to my promise, I have herewith sent you my observations upon mr *Sutton's* machine, which I drew up sometime since, and intended to lay before the royal society in *December* last, before I knew either that a model would be shewn by mr *Sutton*, or that dr *Mead* would have presented his account thereof. I am con-

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scious

scious of the disadvantages my slender performance must appear under after the reading of one upon the same subject from so celebrated a pen as dr *Mead's*.

THESE remarks were the result of several times seeing the machine, when first put in execution at *Deptford*. I hope it will not take up too much of the society's time to read my paper this evening, and am,

SIR,

Your most obedient

bumble servant,

ALDERSGATE-STREET,
Thursday Morning,
April 1. 1742.

W. Watfon.

Some



Some observations upon mr Sutton's invention to extract the foul and stinking air from the well and other parts of ships, with critical remarks upon the use of wind-sails, by William Watson, F.R.S.

London, Dec. 4. 1741.

*Read April 1.
1742.*

AS nothing is more conducive to the health of the human body, than the taking a sufficient quantity of wholesome air into the lungs, so the contrary is attended with pernicious and often with destructive consequences.

One of the great uses of air in inspiration is to cool the blood passing through the lungs, where nature has provided, according to the excellent *Malpighius*, that the

blood should be distributed through a vast number of exceedingly fine arteries, which occupy the thin vesicles of the lungs; and by this means the blood is exposed to the air under a prodigiously large surface, whereby the putrefaction is prevented, which, from the alcalescent quality of that fluid, would otherwise be speedily destructive.

Observations inform us, that contagious distempers are more frequent in hot climates than in cold; and in closely built cities full inhabited, than in towns: the former may, in some measure, proceed from the too great heat of the air, not fully answering the above-mentioned purposes; and the latter from too many people breathing in the same atmosphere, thereby rendering it unfit for respiration.

It

It has been frequently tried, that if a gallon of air be contained in a bladder, and by means of a blow-pipe, inspired and expired into the lungs of a man, without having any communication with the external air; in the space of a minute, or little more, it becomes heated, and unfit for respiration; and without the addition of fresh air, the person making the experiment would speedily be suffocated. The diving-bell is another instance of the same kind, wherein a constant supply of fresh air must be had, to keep out the water, and refresh the people included.

Although air is absolutely necessary to our existence, and necessity constrains us inevitably to breathe therein, it may be made a vehicle of most malignant poisons, as witness the famous *Grotto del Cani* in *Italy*, the poisoning
air

air by charcoal, and air impregnated with the fumes of fermenting vegetable liquors. Stagnant air either alone or mixed with water, soon becomes very offensive and pernicious ; as in wells dug for the supply of water, and disused for some time ; as is the air also in the wells and in the holds of ships, which is occasioned principally by what is usually called the Bulgewater, which if the ship is tight, and not frequently pumped, becomes not only very offensive, but so extremely poisonous, as frequently to suffocate those seamen, who, as the pumps are subject to be clogged with filth, venture down to cleanse them ; and will cause also in persons at a distance violent head-achs, cold sweats, and frequent vomitings, which continue more or less, in proportion to the distance from the well of the ship when the injury

jury was received, and the degree of putrefaction in the water and air.

The air, in ships particularly, is very liable to be vitiated, not only from the Bulge-water, but from too many people breathing in the same atmosphere; especially in ships of war, hospital-ships, and those used in the *Guinea* trade for *Negroes*; where a number of uncleanly people, being stowed too close together, heat the air, make it replete with noxious *effluvia*, destroy the particles therein adapted to cool the lungs, particularly the acid nitrous *gas*. This principle is abundant in cool air, and manifests itself not only from the quantity of nitrous crystallizations, which may be collected from caverns of the earth, especially those open to a northerly aspect, but also from exposing pieces of the flesh of animals
fresh

fresh cut, or their blood, whereby the colours of their surfaces are soon changed from a dark deep red to a more lively and florid one. Air robbed of this valuable property, and replete with hurtful ones, not only from the people, but from the stinking water in the well and lower parts of the ship, must produce the most putrid, if not pestilential fevers.

Although the *æquilibrium* within places confined is maintained by the external air, yet unless, by openings properly adapted, the air is suffered to pass freely enough, the external air proves as a stopple to the internal, and only mixes with that portion of it which is next in contact: this is evident from the common occurrence in privies, which are scarcely offensive in clear, weather, but are much so in foul or windy, from a diminution
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of the incumbent pressure of the atmosphere, when the vapours that have been pent up, expand themselves to a considerable distance.

To prevent the abovementioned inconveniencies, and to preserve the healths and lives of the seamen, that valuable part of the nation, many schemes have been thought of; particularly the machines of those two very worthy ingenious and industrious members of this society, the rev. dr. *Hales*, and the rev. dr. *Desaguliers*; the first by an instrument which he calls *the ship's Lungs**, and the latter by a machine†, which is an improvement of the *Hessian* bellows; but as these have been laid before the society by the gentlemen themselves, I

* See dr. *Hales's* treatise of ventilators.

† See *Philos. Transf.* no. 437.

shall pass them over, and proceed to mention the contrivance commonly made use of, I mean the wind-fails. They are made of the common sail-cloth, and are usually between 25 and 30 foot long, according to the size of the ship, and are of the form of a cone ending obtusely, when they are made use of, they are hoisted by ropes to about two thirds or more of their height with their basis distended circularly by hoops, and their apex hanging downwards in the hatchways of the ship; above each of these, one of the common sails is so disposed, that the greatest part of the air, rushing against it, is directed into the wind-fail, and conveyed, as through a funnel, into the upper parts of the body of the ship. These must be hung up and taken down every time they are used, and the supply by this method

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is not constant. Though custom has given a sanction to this device, it is subject to many inconveniencies: 1st, Each ship having commonly three of these, (one to each mast) the seamen are a considerable time in getting their apparatus ready, and in hoisting them up to make use of. 2^{dly}, They can only be used in mild weather. 3^{dly}, Near the equator, where fresh air is most wanted, there sometimes happen such stark calms, that they are useless by not having air enough to distend them. 4^{thly}, The air hereby admitted passes only into the upper and more open parts of the ship, so that the well, &c. receive no change therefrom; and it is observed, that sometimes, upon using them after some discontinuance, they drive offensive air into the cabin, and more airy parts of the ship; like as the pouring some

fresh into stinking water makes the whole stink, though in a less degree. *5thly*, they are improper to be used in the night-time, when the people are sleeping between decks. And *lastly*, admitting they had none of the former inconveniencies, their use must be destructive in hospital ships; where though fresh air imperceptibly received is absolutely necessary to preserve the crew as free as possible from the infectious breath and exhalations of the diseased and wounded seamen; yet blasts of wind, pouring impetuously into the very places where the sick lie, must be attended with such consequences as are too obvious to mention.

To remedy these inconveniencies, to prevent the air proving foul even in the wells and holds of ships, and to cause imperceptibly a large circulation

culatation of fresh air into every part of the ship at all times, mr. *Sutton* has invented the following scheme, which is useful not only in these cases, but, by altering some parts as particular places require, may be applied to houses, the close parts of prisons, wells at land, privies, hospitals, &c.

Nothing rarefies air so considerably as heat, which whenever it causes a diminution in the density of the air, that part next in contact will rush in, and be succeeded by a constant supply, till the air becomes of an equal degree of elasticity. Therefore, if a tube be laid in the well, hold, or any other part of the ship, and the upper part of this tube be sufficiently heated to rarefy the impending column of air, the *æquilibrium* will be maintained by the putrid air from the bottom
of

of the tube, which being drawn out this way, a supply of fresh air from the other parts of the ship will succeed in its place, which operation, being continued, will intirely change the air in all parts of the ship. This principle, exactly conformable to the doctrines of pneumatics, is the basis of mr. *Sutton's* machine, which being put in execution on board the *Hulk* at *Deptford*, before the lords of the admiralty, commissioners of the navy, our very learned and ingenious, president *M. Folkes*, esq; dr. *Mead*, &c. performed to their satisfaction, in bringing air from the bread-room, horlop and well of the ship at the same time, in such quantity, that large lighted candles being put to the end of the tubes, the flame was immediately sucked out as fast as applied, though the end of one of the tubes was above twenty yards distant

distant from the fire. The method is as follows:

To boil the provisions of the ship's company, they must have a copper, which is bigger or less, in proportion to the size of the ship, and number of the crew: this copper is fixed in ships in the manner as on land, having under it two openings divided by an iron grate. The first opening, having an iron door, is for the fire; the ashes from the grate drop through into the bottom of the other; the smoke passes through a chimney, and is discharged as usual. After the fire is lighted, it is supported by the air from the parts next the ash-pit; but having contrary to the usual custom, adapted an iron door, like the former, made very tight, to prevent the ingress of air, the fire would soon be extinguished, if not supplied by some other aperture:
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in order to which, one or more holes are made through the brick-work in the side of the ash-pit; and tubes of lead or copper, fitted closely in the holes, and made fast, are laid from thence into the well, and other parts of the ship; by which means the air next the bottom of the tubes rushes through them, and the foul and stinking air succeeding is transmitted through the fire, and passes off, without offending, by means of the chimney; and a supply of fresh air from the other parts of the ship continually fills the place of the former, the fire requiring a constant support. This support will be wanting, not only during the continuance of the fire, but while any warmth remains in the fire-place, copper, or brick-work, as was observed on board the *Hulk* at *Deptford*, where the draught of
air

air through the tube lasted above twelve hours after the fire was taken away. This being considered, as the dressing the provisions for a number of people will take up some hours every day, the warmth of the brick-work and flues will continue a draught of air from one day to the next. Mr. *Sutton* proposes thus to circulate the air by the same and no greater expence of fire than is customarily used for the necessities of the ship.

The operation of the machine will be equally useful in large as in small ships; for the greater the number of people they have on board, the larger quantity and longer continuance of the fire will be necessary to dress the provisions; and therefore there will be required a greater quantity of air to support that fire. The size and number of the tubes need not be specified; because as

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the circulation of air is in proportion of the quantity of fire; the wider the tube, and greater the number of them, the less the velocity of the air, and *vice versa*.

I several times took notice in this machine, when, for the sake of observation, after the fire was well lighted, the lowest iron door was left open, that the flame did not ascend so high, or burn so fierce; but immediately upon shutting thereof, when the draught of air was only through the tubes, the flame soon recovered its former vigour.

There is likewise, especially in large ships, not only a copper, but also a fire-grate like those used in kitchens: that the heat and smoke of this also may not be useless, an iron tube may be fixed behind the grate, and inserted quite through the brick-work, and through the deck, so that one end thereof will stand

stand about a foot, or little more, in the chimney above the brick-work, and the other will enter into the hold, or any other part of the ship; the upper end of this tube then being heated, the draught of air will be supplied from below, as in the other case. This likewise was tried on board the *Hulk*, with an iron tube about two inches and an half in diameter, and the lighted candles held at the bottom of this tube were extinguished as fast as by any of the others.

It may be objected, that a number of tubes take up too much room, especially in merchants ships, and are subject to be broken or injured by loading or unloading: to remedy which it is adviseable, that only one tube of a convenient size be made fast unto the side of the ash-pit, and, as soon as it comes through the main deck, to compress it (a

circular or any other form being equally useful) not too close; and it may be divided into as many ramifications as may be thought necessary, (especially as the bread-room, store-room, &c. cannot be kept too sweet, a branch for each of these) and these branches may be carried between the beams which support the deck, till they come to the side of the ship, and there be let down likewise between the beams into the places intended; by which contrivance their operation will not in the least be obstructed, and the tubes be secured from any accident.

The simplicity of this machine, it being so little cumbersome, its operation without any labour to the seamen, the small expence to put it in execution, and maintain it, besides the before-mentioned considerations, are other arguments for its general use.

Con-



*Continuation of the historical
account of a new method,
&c.*

S I R,

SINCE my first letter to you,
giving *an historical account of
my method for extracting foul air
out of ships, &c.* I have made
such improvements in it, that I
am convinced it is now perfect,
and will produce all the benefits
that can be expected from a free
circulation of fresh air in close
places; without any of those ima-
ginary inconveniences, that by
some few were apprehended from
it.

it. And my conviction does not arise from the truth of the principles alone, on which it is founded ; but likewise from impartial experiments made with my machine during long voyages in several parts of the world ; and ample testimonials of its salutary effects, where-with I have been honoured ; the most material of which you will find at the foot of this letter.

I HAVE now the satisfaction to inform you, that my invention has at length surmounted all obstacles through the wisdom and zeal of the present right honourable the lords of the admiralty, and the right honourable and honourable the principal officers and commissioners of his majesty's navy, who, having taken the whole affair into their serious consideration, were so thoroughly satisfied of the great advantages

vantages that must accrue to the nation from the faithful execution of my scheme; that the said principal officers and commissioners of his majesty's navy have contracted with me for fixing my engine on board his majesty's ships, whether laid up, or in commission: for which act of general concern, as I well know the warmth of your heart for the good of our country, I doubt not but you will readily concur with me in making cordial acknowledgments to their lordships and those honourable gentlemen in the name of the public.

Your's, &c.

SAMUEL SUTTON.

EXTRACT



EXTRACT *from the right honourable the lord ANSON's voyage round the world, p. 36. of the edition in 4to, shewing the want of an engine to extract the foul air.*

THE captains of the squadron represented to the commodore, that their ships companies were very sickly, and that it was their opinion, as well as their surgeon's, that it would tend to the preservation of the men to let in more air between decks; but that their ships were so deep, they could not possibly open their lower ports. On this representation, the commodore ordered six air-scuttles to be cut in each ship, in such places, where they would least weaken it.

And

And on this occasion I cannot but observe, how much it is the duty of all those, who either by office or authority, have any influence in the direction of our naval affairs, to attend to this important article, the preservation of the lives and health of our seamen. If it could be supposed, that the motives of humanity were insufficient for this purpose ; yet policy, and a regard to the success of our arms, and the interest and honour of each particular commander, should naturally lead us to a careful and impartial examination of every probable method proposed for keeping a ship's crew in health and vigour. But hath this been always done ? Have the late invented plain and obvious methods of keeping our ships sweet and clean, by a constant supply of fresh air, been consider-

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ed with that candour and temper, which the great benefits promised thereby ought naturally to have inspired? On the contrary, have not those salutary schemes been often treated with neglect and contempt? And have not some of those, who have been entrusted with experimenting their effects, been guilty of the most indefensible partiality, in the accounts they have given of these trials? Indeed, it must be confessed, that many distinguished persons, both in the direction and command of our fleets, have exerted themselves on these occasions with a judicious and dispassionate examination, becoming the interesting nature of the inquiry; but the wonder is, that any could be found irrational enough to act a contrary part, in despite of the strongest dictates of prudence and humanity. I must
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however own, that I do not believe this conduct to have arisen from motives so savage, as the first reflection thereon does naturally suggest: but I rather impute it to an obstinate, and in some degree superstitious, attachment to such practices as have been long established, and to a settled contempt and hatred of all kinds of innovations, especially such as are projected by landmen and persons residing on shore.





TESTIMONIALS of the advantages and success of my machines for purifying the air in ships, and other close places.

NUM. I.

EXTRACT of a letter from rear admiral Boscawen to mr Corbett, dated in Table-bay, 9th April 1748.

THE squadron as well as the troops, who are with me, are surprisfingly healthy, and have been fo in general our whole passage; which I attribute in a great measure to our having touched at the islands, where I procured refreshment.—But at the same time I cannot help thinking, the *air-pipes*

pipes fixed in the men of war have been of great service in this particular, by purifying the air between decks, and thereby preventing the scurvy.

In addition to what I have said above of the air-pipes, I cannot help observing to their lordships, that the bulge-water on board the *Namur* in particular, has not been the least offensive the whole passage; tho' it was so bad when we last went into *Portsmouth* harbour, that three or four men were like to be suffocated, by only coming near the well: and therefore I cannot but recommend them as things highly useful on board his majesty's ships.

NUM.

NUM. II.

MR. *Joseph Hatton*, carpenter of the *Warwick* man of war, during her voyage to *Guinea*, and the *West-Indies*, mentioned above p. 19, declared at the navy-board, that on the accident of breaking the chain of their pump, it fell with a kink in the chain, so that it could not be got up or down ; wherefore he was obliged to go into the well, in order to cut a scuttle in the pump to clear the kink : that he remained in the well near five hours in a considerable depth of water, without any ill effect on his health ; which he imputes to the pipes being fixed on board the said ship for extracting the foul air.

NUM.

NUM. III.

Captain *Petre*, commander of the *Sandmich*, in the service of the *East-India* company, on board of which ship mr *Sutton* had constructed one of his machines, declared at the navy-board, that on his return from a *Cbina* voyage in 1747, when he put in at *Ireland*, he ordered some of the bulge-water to be brought up; and it differed not in smell from other common sea-water, but differed in colour as the liquor of bohea from green tea.

NUM.

NUM. IV.

EXTRACT of a letter from captain William Lisle, commander of his majesty's ship the *Vigilant*, at the Cape of Good Hope, April the 10th 1748.

I Gave you an account of all that occurred till I left *Madeira*, in a letter from thence: however, that you may form a better idea of the tedious passage to this place, I shall just mention the dates of our departure from the several ports we touched at in our passage. We left *Spithead* the second of *November*, *Lisbon* the 24th of *January*, and arrived at the *Cape of Good Hope* the twenty-second of *March*; by which you may observe, that our passage from *Madeira* to this place was just

just eleven weeks, and our whole vbyage from *England* full five months, if we fix each month at twenty-eight days: which is a long time to be getting but little more than half-way to our journey's end; but tho' long, yet it has been attended with very few bad circumstances: and particularly in regard to the health of the several ships companies, and all the troops in general, never were people more healthy; which I cannot but suppose is entirely owing to the new-invented Ventilators*, and the large quantity of mustard-seed allowed by the government to the seamen, by way of experiment. The *Dutch* who reside here, speak of it as a miracle, and make it the chief subject of their conversation.

* N. B. These are mr *Sutton's* air-pipes.

*An Abstract of the letters patent,
granted by his majesty, for the
aforesaid invention.*

GEORGE the Second, by
the Grace of God, of Great
Britain, France, and Ireland, king,
defender of the faith, &c. **To all,**
to whom these presents shall come,
greeting, **Whereas** our trusty and
well-beloved *Samuel Sutton*, of our
city of *London*, brewer, hath, by
his petition, represented unto us,
that he has after long study, much
pains, great expence, and repeated
experiments, found out, and brought
to perfection, a new invention or
method for extracting foul air out
of ships by means of fire, and will
equally contribute to the removing of
all noxious air whatsoever, and may
be conveniently applied to mines
and caverns in the earth, dungeons,
prisons,

prisons, and all infected places; that the said invention may be likewise used in hot-houses and walls, which will greatly warm the earth, for the speedy production of it's fruits, and also in granaries for the preservation of corn and grain; that the said invention will greatly tend to the preservation of the lives of great numbers of our subjects, and be of publick use and benefit to this our kingdom in general: and as the petitioner is the first and sole discoverer of the said invention, or method, and also, in regard to the great expence of money and time, the petitioner has sustained, in making so valuable a discovery; he therefore most humbly prays us, that ~~We~~ we would be pleased to grant him our royal letters patent, for the sole use and benefit of his said new invention, within that part of our kingdom of *Great Britain*, called

England, and the dominion of
Wales and town of *Berwick* upon
Tweed, and in our plantations in
America, for the term of fourteen
years, according to the statute in
such case made and provided :
We being willing to give en-
couragement to all arts and inven-
tions, which may be for the pub-
lick good, are graciously pleased to
condescend to the petitioner's re-
quest. **Know ye** therefore, that
We of our especial grace, certain
knowledge, and meermotion, **have**
given and granted, and by these
presents for us, our heirs and suc-
cessors, **do** give and grant unto the
said *Samuel Sutton*, his executors,
administrators, and assigns, our
especial licence, full power, sole
privilege, and authority, that he,
the said *Samuel Sutton*, his exe-
cutors, administrators, and assigns,
and every of them, by himself,
and

and themselves, or by his and their deputy or deputies, servants or agents, or such others as he the said *Samuel Sutton*, his executors, administrators, or assigns, shall at any time agree with, and no others, from time to time, and at all times hereafter, during the term of years herein expressed, shall and lawfully may make, use, exercise, and vend his said invention, within that part of our kingdom of *Great Britain* called *England*, our dominion of *Wales* and town of *Berwick upon Tweed*, and our colonies and plantations in *America*, in such manner, as to him, the said *Samuel Sutton*, his executors, administrators, and assigns, or any of them, shall in their discretions seem meet: **and** that the said *Samuel Sutton*, his executors, administrators, and assigns, shall and lawfully may have and enjoy the whole profit, benefit, commodity,

commodity, and advantage, from time to time, coming, growing, accruing, and arising, by reason of the said invention, for, and during the term of years herein mentioned, **To have, hold,** exercise, and enjoy the said licence, powers, privileges, and advantages herein before granted, or mentioned to be granted, unto the said *Samuel Sutton*, his executors, administrators, and assigns, for and during, and unto the full end and term of fourteen years, from the date of these presents next, and immediately ensuing, and fully to be compleat and ended, according to the statute in such case made and provided. **And** to the end, that he the said *Samuel Sutton*, his executors, administrators, and assigns, and every of them, may have and enjoy the full benefit, and the sole use, and exercise, of the said invention herein before declar'd;
We

We do by these presents, for us, our
 heirs and successors, require, and
 strictly command all and every per-
 son, and persons, bodies politick
 and corporate, and all other our
 subjects whatsoever, of what estate,
 quality, degree, name, or condi-
 tion soever they be, within that
 said part of our kingdom of *Great*
Britain, called *England*, our do-
 minion of *Wales*, and town of *Ber-*
wick upon *Tweed*, and our colonies
 and plantations in *America* afore-
 said, that neither they, nor any of
 them during the continuance of the
 said term of fourteen years hereby
 granted, either directly, or indirect-
 ly, do make, use, or put in practice
 the said Invention, or any part of
 the same so attained unto by the
 said *Samuel Sutton* as aforesaid,
 nor in any wise counterfeit, imitate,
 or resemble the same, nor shall
 make, or cause to be made, any ad-
 dition

dition thereunto, or subtraction from the same, whereby, to pretend himself, or themselves the inventor or inventors, deviser or devisors thereof, without the licence, consent, or agreement of the said *Samuel Sutton*, his executors, administrators, or assigns, in writing under his or their hands and seals, first had and obtained in that behalf, upon such pains and penalties as can or may be justly inflicted on such offenders, for their contempt of this our royal command ; and further, to be answerable to the said *Samuel Sutton*, his executors, administrators, and assigns, according to law, for his and their damages thereby occasioned. **And moreover We do** by these presents for us, our heirs and successors, will and command all and singular the justices of the peace, mayors, sheriffs, bailiffs, constables, headboroughs,

roughs, and all other officers, and ministers whatsoever of us, our heirs and successors, for the time being, that they or any of them do not, nor shall at any time hereafter, during the said term hereby granted, in any wise molest, trouble, or hinder the said *Samuel Sutton*, his executors, administrators, or assigns, or any of them, or his, or their deputy, servants, or agents, in or about the due and lawful use or exercise of the aforesaid invention, or any thing relating thereto.

And lastly, we do by these presents, for us, our heirs and successors, grant unto the said *Samuel Sutton*, his executors, administrators, and assigns, that these our letters patent, or the inrollment or exemplification thereof, shall be in and by all things good, firm, valid, sufficient and effectual in the law,
O accord-

according to the true intent and meaning thereof, and shall be taken, construed, and adjudged, in the most favourable and beneficial sense, for the best advantage of the said *Samuel Sutton*, his executors, administrators, and assigns, as well in all our courts of record as elsewhere, and by all and singular the officers and ministers whatsoever of us, our heirs and successors, in that part of our said kingdom of *Great Britain* called *England*, or dominion of *Wales*, and town of *Berwick upon Tweed*, and our colonies, and plantations in *America* aforesaid, and amongst all and every the subjects of us, our heirs and successors, whatsoever and wheresoever, notwithstanding the not full and certain describing the nature or quality of the said invention, or of the materials thereto conducing and belonging. In wit-
ness

(91)

ness whereof we have caused these
our leters to be made patent.
Witness ourself at *Westminster*,
the sixteenth day of *March*, in the
seventeenth year of our reign.

By writ of privy seal.

C O C K S.



O 2

A

1875
The following is a list of the
names of the persons who
were present at the
meeting of the
Board of Directors
of the
City of New York
on the 1st day of
January, 1875.

A. S. O.



A

DISCOURSE
ON THE
SCURVY.

THE Scurvy is a name given to so many disorders of the body seemingly of a different kind, that it may justly be said to be a manifold and complicated disease. The chief symptoms of it however are clearly described by several authors, which are such as these: the gums rot first; then the skin is defaced with livid and black spots; ulcers ensue, especially in the swelled legs;

legs ; and these are with difficulty, if ever, cured. In the last stage of the distemper, even the bones become carious.

It is therefore very plain, that this malady is a kind of corruption of the blood, and the whole mass of the bodily humors. This, when the cause is long continued, increases to a degree of putrefaction. All writers are agreed in their opinion, that it is a northern disease ; imputing it to the cold and moist air of those climates, together with the use of stagnating and saltish waters, and the unwholesome food of hard, dried and salted meats. They therefore observe that it rages most, even to be, in a manner universal, among the inhabitants of the *Baltic sea*, in *Finland*, *Norway*, *Denmark*, and the places adjacent to the *Germanic ocean*. And indeed

indeed not only the new Latin name, *Scorbutus*, but our English one too, is plainly made from the Saxon *Schorbock*, or *Schorbuck*, denoting a griping or tearing of the belly (a).

THIS is the same distemper, which *Pliny*, from the ulcers in the mouth and legs, calls by the names of *Stomacace*, (or rather *Stomocace*) and *Sceletyrbe*; ascribing it to the drinking of bad waters; and for which, he says, the *herba Britannica*, which is our *hydrolapathum*, or *waterdock*, was found to be a remedy (b).

BUT long before this, *Hippocrates* (c) himself took notice of

(a) Vid. Eugalen de Scorbuto. & in primis Sennert. Lib. iii. Part. v.

(b) Nat. Histor. Lib. xxv. Sect. vi.

(c) De internis Affection. Sect. xxxiv. & de Aërib. Aquis & Locis. Sect. x.

this

this disease, as a distemper of the spleen, proceeding very much from cold, raw, and turbid waters.

SUCH is this distemper at land. At sea, in long voyages, it is much more violent; so far, that many are of opinion, that upon the two elements it is a malady of a different kind. But it plainly appears from comparing what has been said of that at land, with what I am going to mention of the same at sea, that the difference is only in the degree of malignity.

THE history of the progress of this cruel enemy is so judiciously and exactly related in *lord Anson's voyage round the world* (d) when he came into the *South sea*, where his men were in a most terrible

(d) Pag. 100, &c.

manner afflicted with it, that I cannot give a more lively description of it, than by taking out of this most entertaining and instructive book the most material circumstances, which occurred in its several stages. This I am the better enabled to do, because being incited by the extraordinary events to make a full enquiry into this whole affair, I have not only had the honour of discoursing with his lordship upon it, but have also been favoured with the original observations of his two ingenious and skilful surgeons (*e*), from which I have leave to transcribe whatever I find to my purpose.

The first appearances are much the same in the two diseases at

(*e*) Mr. *Ettrick* and Mr. *Allen*.

P

land

land and at sea ; but at sea they soon run to a much higher degree. Nothing is more surprizing than the malignity of this, as it were corrosive, poison, exerting itself so far, that the scars of wounds, which had been many years healed, were often forced open again. Nay the *callus* of broken bones, which had been completely formed for a long time, was found dissolved, and the fracture seemed as if it had never been consolidated.

THIS malady was likewise accompanied with many other dangerous symptoms, particularly putrid fevers, pleurifies, the jaundice, an obstinate costiveness, and, at the latter end, a difficulty of breathing. This last was found to be the most deadly of them all: for it never was without such a faintness and weakness, that many expired

expired upon the least motion, and endeavouring to get out of their hammocks, died before they could reach the deck.

MOREOVER, a strange dejection of the spirits, with shiverings, tremblings, and dreadful terrors on the slightest accidents, was so constant an attendant, that whatever discouraged the sick never failed to add new force to the distemper.

SUCH are the strokes of this compounded calamity ; and many more might be enumerated : but it is time to proceed, and to inquire into the manner, by which they are produced.

It is certain, that such bad diet as has been mentioned, will corrupt the blood and humors ; but nothing is clearer from the whole

history of this voyage, than this, that the air is, even more than any other agent, concerned in bringing on the mischief (*f*). It may indeed justly seem strange, that the writers of physick should not have observed so remarkable a cause; but they described the land scurvy only. Nay, so great was the efficiency of the aerial fluid, that even a warmer climate did not mitigate the scorbutic virulency; neither did fresh provisions, and plenty of wholesome rain-water avail; altho' these are certainly of great importance in preserving the body from the fatal disorder. Of so much consequence it is to resist the first approaches of an enemy.

Now the manner, in which the aforesaid causes act, is this. Who-

(*f*) See Voyage, p. 294.

ever

ever understands the use of respiration, and the way by which the several offices necessary to life are performed by means of it, will readily comprehend how the sea air acquires such noxious qualities.

To set this in a clear light, it must be observed, that air entering into the lungs does by its gravity and elasticity press upon the blood circulating in the vessels there. The effect of this pressure is two-fold; first, a comminution and division of it into smaller particles; secondly, some subtle elastic matter passes into the blood, and exciting in it an intestine motion, disposes and prepares it for the secretions of several liquors, when, in its course round the body, it arrives at the glands contrived
for

for the separation of such and such juices.

WHATEVER therefore alters this gravity and elasticity, makes the air unfit for the purposes, for which it was designed. In the first place, moisture weakens its spring; next, a combination of foul particles, such as are contained in the breath of many persons crowded together, and some perhaps diseased; then, the filthiness of water stagnating in the bottom of the ship; lastly, salts imbibed from the sea, some of which may probably have proceeded from putrefied animals in that element, may insinuate themselves into the blood, and, in the nature of a ferment, corrupt its whole mass. Neither is it amiss to add, that the animal spirits themselves must necessarily partake of the vicious disorder

disorder of the fluid, from which they are derived. This is plain from that unaccountable faintness, and weakness of the body, and dejections of mind, which, as we have before taken notice, accompany the other symptoms.

It is needless to shew how all the enumerated complaints, and indeed many more, may follow upon such a disturbed state of things, especially when the other mentioned causes concur. It may be very satisfactory to put down the observations, which the above-named surgeons made upon the blood of their patients, and upon the dissection of dead bodies, in the several stages of the distemper.

In the beginning, as it flowed out of the orifice of the wound,
it

it might be seen to run in different shades of light and dark streaks. When the malady was increased, it ran thin and seemingly very black, and after standing some time in the porringer, turned thick, of a dark muddy colour, the surface, in many places, of a greenish hue, without any regular separation of its parts. In the third degree of the disease, it came out as black as ink, and though kept stirring in the vessel many hours, its fibrous parts had only the appearance of a quantity of wool or hair floating in a muddy substance.

IN dissected bodies, the blood in the veins was so entirely broken, that by cutting any considerable branch, you might empty the part, to which it belonged, of its black and yellow liquor. When
found

found extravasated, it was of the same kind. And lastly, as all other kinds of hæmorrhages are frequent at the latter end of the calamity, the fluid had the same appearance, as to colour and consistence, whether it was discharged from the mouth, nose, stomach, intestines, or any other part.

THE effects we mentioned of the violence of the scorbutic humor being so malignant as to open the scars of old wounds, and dissolve the *calli* of fractured bones, which had for a long time been formed, appear to many to be quite incredible; the rather, because, as they commonly say, a bone thus reunited is stronger in that part than in any other of the same joint. This indeed, I dare venture to affirm, is not true in

Q

fact.

fact. The case is thus: a *callus* is no more than a kind of cementation made by filling up the space between the broken ends of the bone, with the nutritious juice from the part. This when nicely examined, is found to be more porous, and to have less solidity, tho' the bone often appears bigger than the part above and below it; the fibres are smaller, shorter, and not so regularly disposed as in the natural texture. In short, a *callus* is an imperfect ossification. For this reason, when the nutritious particles themselves have acquired a corrosive acrimony, they may, like a *menstruum*, work upon and break the texture of this superadded cement. Which is indeed a most surprising *phaenomenon*.

It

It is proper after all to observe, as a confirmation of this reasoning, that although the *callus* is dissolved by the disease, yet upon the patient's recovery, it is gradually formed again, in proportion to his coming to a right habit of body. I have before me a remarkable instance of this kind. A sailor had one of his *clavicles* fractured in *December*, which was immediately reduced, and soon united. The dressings were taken off in *January*, and he made use of his arm as before. In the following *April*, as he was suspending his body by the arms, the same clavicle was disunited, and the *callus* gave way as at first. He at that time complained of some symptoms of the Scurvy; which daily increased till *June* following. At that time he was carried ashore

at the island of *Juan Fernandez*, The bandages being removed, the fracture appeared in the same condition as when the accident first happened, without the least remains of a *callus* : notwithstanding the proper applications he could not use his arm, until the middle of *October* ; the *callus* having continued more than three months in a flexible state. From that time, by the use of a vegetable diet, and living on shore, he gradually recovered from the distemper ; the *callus* was confirmed, and his usual strength returned.

BUT it is time to come to the cure ; which will be, first to prevent the attacks ; and in the next place, to remove the effects of this virulent evil.

THE

THE first care to be taken is of the diet. And here I must take the liberty to make some observations upon the manner of victualling our ships. The trials already made, as I have been informed, of Mr. *Lowndes's* salt made from brine, prove it to be much preferable, for salting provisions, both flesh and fish, to that made from sea-water, even to the bay-salt. Some experiments of its use I have made myself; and our college, being consulted by the lords of the admiralty, gave their opinion in its favour. There is in this nothing of that noxious quality, whatever it be, which is always found in the marine salt, and cannot, by any known methods, be separated from it; and which, as we see, makes the sea air, as well as its water, unwholesome.

And

And I cannot but say, that I am sorry to see some of our physicians, of late years, so fond of prescribing the drinking of it to their patients, particularly in scrophulous distempers. I am well assured, that it has sometimes brought on scorbutic symptoms, besides other mischiefs.

I must add, that if, instead of our salt-fish, stock-fish, which is dried without any salt, were provided, it would be more wholesome. The *Dutch* do so; and also, in lieu of oatmeal, they put on board *gort*, which is, as I have been informed, a kind of barley ground; and is not so hot and drying as oatmeal.

I will here relate what that experienced and brave admiral, Sir
Charles

Charles Wager, once told me in a discourse I had with him concerning the health of our seamen. He said, that one year, when he commanded our fleet in the *Baltic*, his sailors were terribly afflicted with the Scurvy; but he observed that the *Dutch* ships, then in company with ours, were much more free from this disease. He could impute this to nothing but their different food, which was *stock-fish* and *gort*; whereas ours was *salt-fish* and *oatmeal*. He was then come last from the *Mediterranean*, and had, at *Leghorn*, taken in a great quantity of lemons and oranges. Recollecting, from what he had often heard, how effectual these fruits were in the cure of this distemper, he ordered a chest of each to be brought upon deck, and opened every day. The men, besides eating what they

they would, mixed the juice in their beer. It was also their constant diversion to pelt one another with the rinds ; so that the deck was always strewed and wet with the fragrant liquor. The happy effect was, that he brought his sailors home in good health.

It is very commonly known, that, in our *East-India* ships returning home, the men are very much affected this way, and that upon their very approach to the island of *St. Helena*, they are strangely relieved by the fresh odoriferous air ; and perfectly recovered, after some days, by eating the fruits we have mentioned, and living chiefly upon the vegetables, which kind nature has supplied that place with in profuse plenty.

WHAT

WHAT has been said may serve for a very good proof of the reasonableness of the advice given some years ago, by our college, to the lords of the admiralty, *viz.* that a quantity of wine-vinegar should be allowed to the company of every ship. This qualifies the salt of the food, and makes some amends for the want of sub-acid fruits. But I must remark, that the vinegar of strong beer has neither the flavour nor the virtue of that from wine; and ought indeed to be forbidden our tables.

I shall conclude what I have to say with regard to feeding on herbs, in the Scurvy, with a remarkable relation, contained in a book published, not many years since, by a *Dutch* physician, on
R this

this subject (g). A sailor, in one of the *Greenland* ships, was so intirely broken, and disabled by this disease, that his companions, when the fishing was over, put him into a boat, and sent him ashore; leaving him there to perish, without the least expectation of a recovery. The poor wretch had quite lost the use of his limbs; he could only crawl about upon the ground: this he found covered with a plant, which, having nothing else to support life, he, continually grasing like a beast of the field, plucked up with his teeth. Every country is, by the bounty of providence, provided with antidotes against the diseases, to which its inhabitants are chiefly liable. In

(g) Observationes circa Scorbutum, auctore Johanne Fred. Bachstrom. Lugduni Batavor. MDCCXXXIV. 12mo. p. 8.

a short time, he was by this means perfectly recovered to his strength, and after his return home, related the fact to this writer. It was soon after observed, that this herb was *cocblearia*, or scurvy-grass. Some of it was, for inquiry's sake, brought over hither in pots, and was found to be somewhat different from that of our country, being more mild, and not so pungent and sharp.

THUS much for the vegetable diet. I must add, that besides the herbs and fruits mentioned, there are many others very wholesome in this disease. Some like *cocblearia*, of a subtle and volatile juice, as the *nasturtium*, *beccabunga*, or *brooklime*; others more cooling, and therefore more proper in hot constitutions, or feverish heats, as *sorrel*, *endive*, *lettuce*, *purslain*, &c.

R 2

And

And indeed, I think it will be best to join in use the hotter with the colder, that they may qualify each other ; especially, because the acid fruits were found, in lord *Anson's* voyage, to be of most extraordinary benefit (*b*).

NEITHER ought it to be omitted, that milk of all kinds, when it can be had, and its whey, which may be clarefied with some of the herbs now named, is an antiscorbutic food and phyfic.

BUT, as the design of this discourse is to demonstrate the usefulness of the preceding machine, it will be right to add some illustrations and observations to those I formerly made in my paper read

(*b*) See Voyage, pag. 117. and also pag. 308.

before

before the royal society, and reprinted in Mr. *Sutton's* book (i).

I have already taken notice, that the reason why the writers upon this disease have not ascribed it more to the air, than they have done, must be, because they were more acquainted with it at land than at sea. Now, it is very plain, that as the hurtful qualities of the sea-air must be heightened by its being closely confined, without due circulation, particularly when it is also saturated with *effluvia* from the breath of many persons almost stifled up together; so the continual shifting and changing of this element, must of course be attended with great advantages; nay such perhaps, as one unacquainted with the nature of things, would hardly be brought to be-

(i) Pag. 41,

lieve. But I refer to my mentioned paper, and Mr. *Sutton's* additions.

I must lastly remark, that it is almost incredible how soon the sick, even tho' just dying, begin, when brought ashore, to feel the salutary effects of the land : for whereas the admiral had buried twenty-one men in two days, before his arrival at the island of *Tinian*, yet he did not lose above ten, during his two months stay there (k). For so healing, and contrary to the malignity and bad qualities of the sea-air, was that of the land, that the patients, even upon their being exposed upon the ground, immediately recovered.

BUT it may seem still more marvellous, that the vapor of the

(k) See Voyage, p. 307.

cold

cold earth itself should also contribute to their speedy recovery. Lord *Anson* told me, that one of his men, who rowed the boat ashore, was so weak, that he fell down at the oar almost dead: when landed, the poor man desired his mates that they would cut a piece of turf out of the soft ground, and put his mouth to the hole: upon doing this, he came to himself, and grew afterwards quite well. This puts me in mind of what I have formerly seen done by the boys on *Shrove-Tuesday*, the too cruel anniversary martyrdom of cocks; when one of these creatures was knocked down and expiring, it was sometimes brought to life again, by instantly putting its head, for a short time, into a fresh-made hole in the earth.

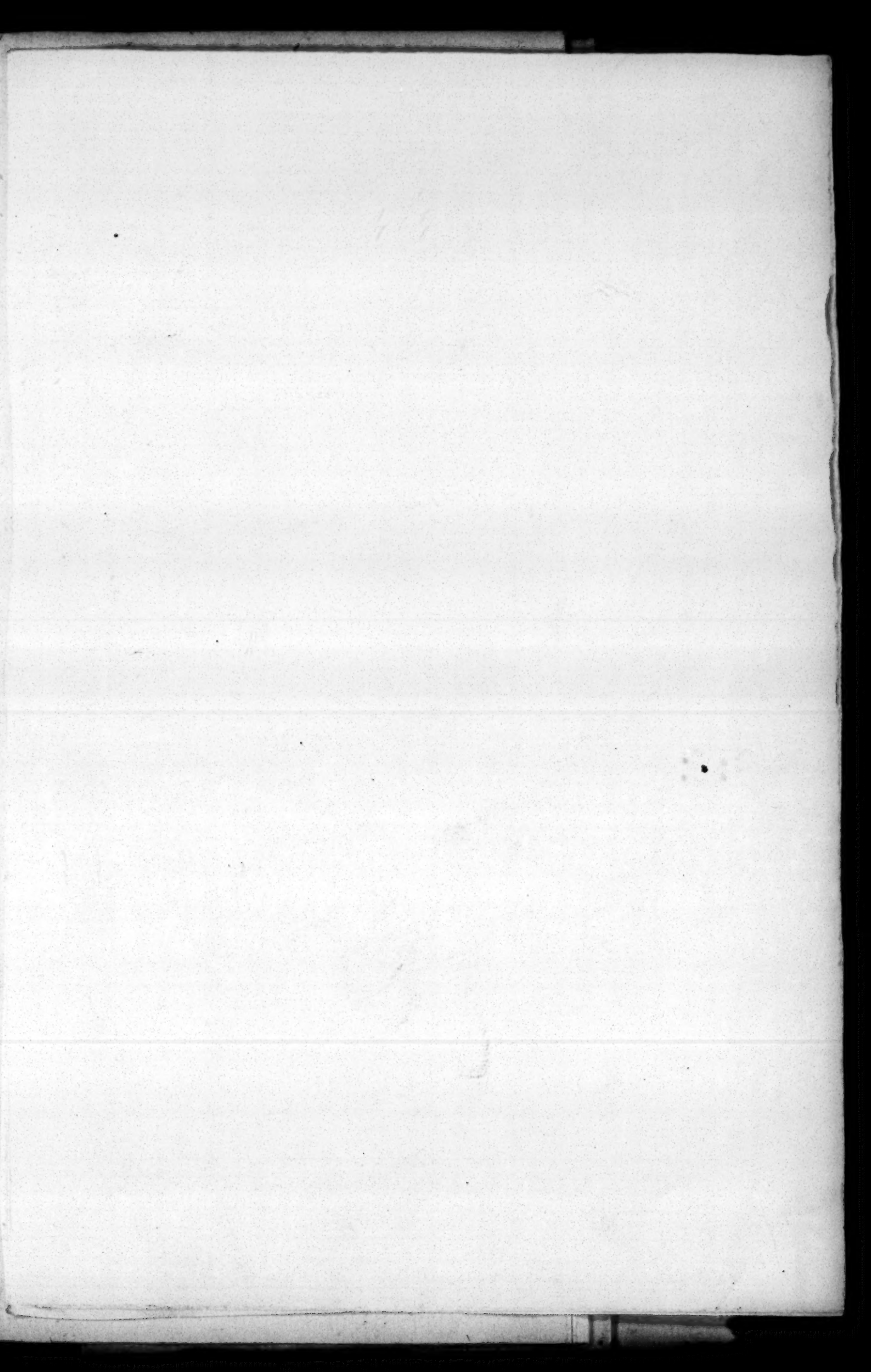
THIS

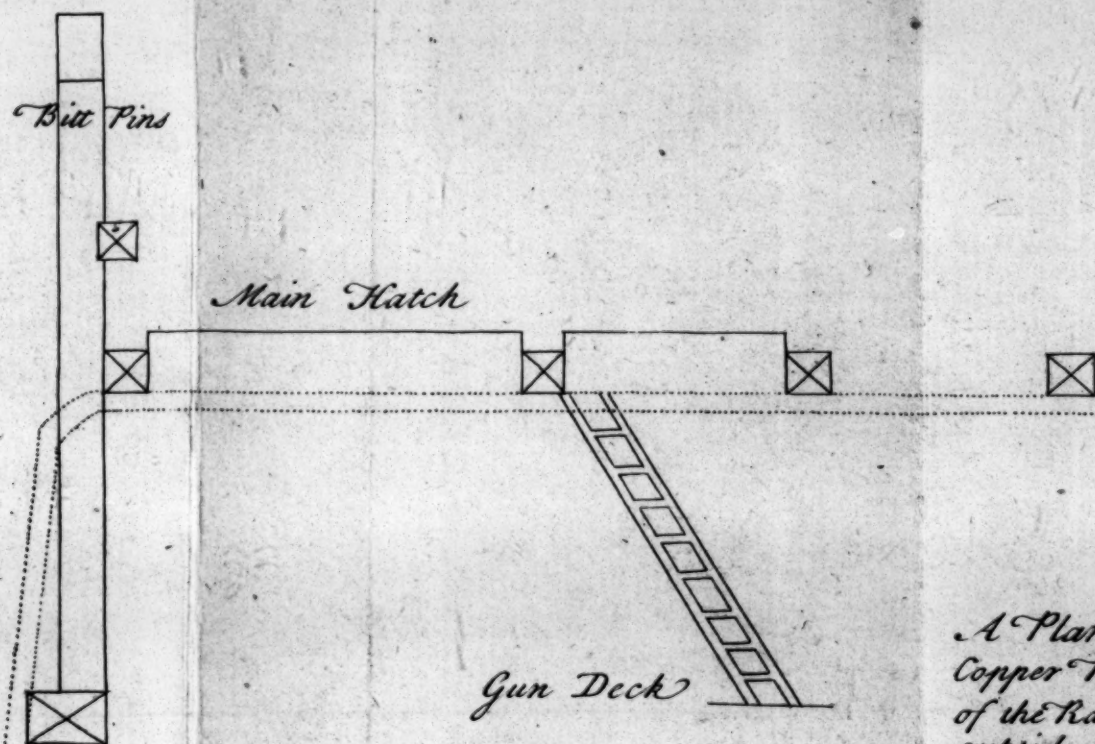
THIS sudden good effect of fresh air affords a plain proof of what we have before said, that besides the blood, the animal spirits themselves are very much affected in this disease: for such immediate relief could only be given by the means of this active fluid, the main instrument of all vital motions. And as the protracting this advantage in the open air is the *cure* at hand; so the making a constant circulation even of that, which is not so wholesome, in the ship, must do a great deal towards the *prevention* of the distemper.

R. M.

The E N D.







*A Plan of the Brick W
Copper Pipes fixd as dir
of the Range and Fire h
outside Copper Pipe that
fixd to it leading down t
half of the Bottom*

A Plan of Furnaces

B. Ash Pitt

C. Oven

D. Vent Hole

E. Copper Pipes in the

F. D° in the

G. Section of the Range a

H. D° Fire Hole under a

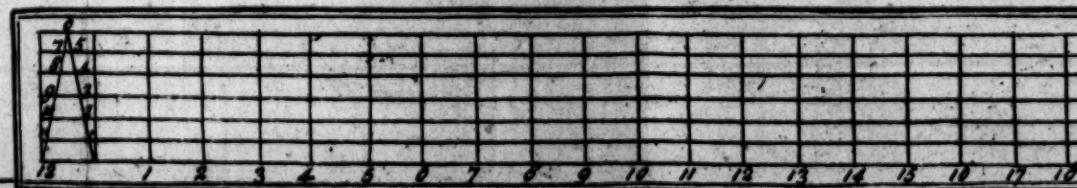
I. The outside Copper Py

K. The form of the Copp

L. The Grates standing b

Well Hole

Feet and Inches.

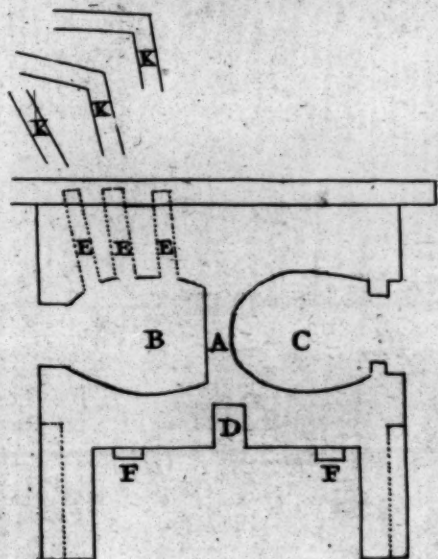
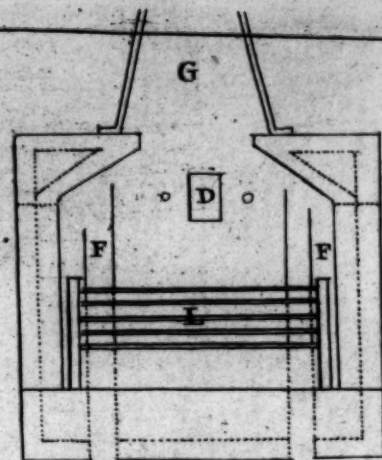
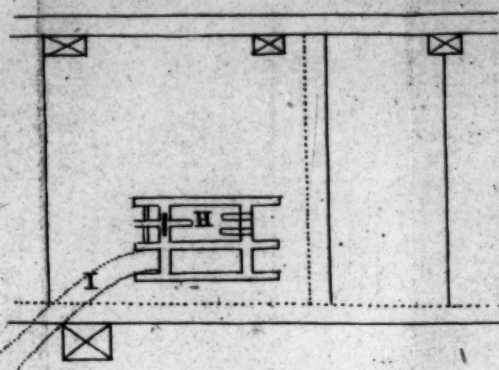
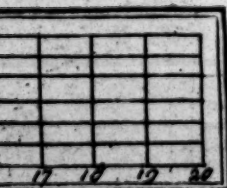


Fore Hatch

rick Work of the Furnaces and Range of the
as directed by M^r. Sutton, with the Section
Fire hole of the great Furnace shewing the
that lays on the Ashpitt with a Ledd pipe
down the Ships Well hole within four feet and

ces

in the Ash Pitt .
in the Range
Range and Copper Chimney
under the great Furnace
ner Pipe that is joinid to the Lead Pipe
e Copper Pipe that is joinid to the Lead Pipe
ding between the Jambs in the Range .



1485 k. 28.